Minotaur's Mysterious Maze

This is an interactive problem.

The Cretan Maze was an elaborate and confusing structure designed and built by the legendary artificer Daedalus for King Minos of Crete at Knossos. Its purpose was to imprison the Minotaur, a mythical creature with the head and tail of a bull and the body of a man.

Though the Minotaur is long gone, the Maze remains, with its magical walls shifting endlessly to confuse anyone who dares to enter. You, a bold adventurer, have become trapped in this ancient maze, surrounded by its eerie and ever-changing corridors.

The Maze consists of a series of **rooms**, each connected in a circular arrangement. Inside each room lies a single **enchanted torch**, which is either **lit** or **extinguished**. However, the number of rooms, n, is **unknown** to you. At any given moment, you can only observe the state of the torch in your current room and have no knowledge of the other rooms' torches.

To escape the Maze, you must deduce n – the number of rooms in the circle. With each step, you can move one room clockwise or counterclockwise, observe the torch's state, and change it if you wish. But be warned: you have only $n + 55$ **steps** to determine the number of torches before the maze shifts again, trapping you inside forever.

Interaction

The state of each torch is encoded by a number.

- 0 represents an **extinguished** torch;
- 1 represents a **lit** torch.

At the beginning, your program will read the number t ($1 \le t \le 555$), the number of test cases. For each test case, your program will interact with the jury's program in a loop. The steps of the loop are as follows:

- First, the jury's program will print a number x ($x = 0$ or $x = 1$) – the state of the torch at your current room.
- Then, your program can make a query by printing one of the following:
  - "**>** y" ($y = 0$ or $y = 1$) – set the current torch to the state corresponding to y and move one room clockwise. You continue the interaction loop.
  - "**<** y" ($y = 0$ or $y = 1$) – set the current torch to the state corresponding to y and move one room counterclockwise. You continue the interaction loop.
  - "**!** n" – answer that the number of rooms in the maze is n, and conclude the interaction for the current test case.

For a test case, your answer will be accepted if your program satisfies the following conditions:

- your program answers n correctly, and
- before answering, your program has not made more than $n + 55$ queries in total. The answer query does not count toward this limit.

It is guaranteed that the sum of n over all test cases does not exceed $10\,000$.

The number of torches n, as well as the initial state of each torch, are **fixed** before the interaction process, and they will only be changed according to your program's queries during the interaction process.

After outputting, do not forget to print a newline and flush the output. To do this, use:

- `fflush(stdout)` or `cout.flush()` in C++;
- `System.out.flush()` in Java;
- `stdout.flush()` in Python.

Sample interaction

The sample interaction is only for demonstrating the interaction process, and does not show how the answer is deduced.

stdin	stdout	Description
2		The number of test cases is 2.
1		The torch in the current room is lit (1).
	> 0	Set the torch to extinguished (0) and moves one room clockwise.
0		The torch in the current room is extinguished (0).
	> 1	Set the torch to lit (1) and moves one room clockwise.
1		The torch in the current room is lit (1).
	< 0	Set the torch to extinguished (0) and moves one room counterclockwise.
1		The torch in the current room is lit (1).
	< 1	Set the torch to lit (1) and moves one room counterclockwise.
0		The torch in the current room is extinguished (0).
	> 0	Set the torch to extinguished (0) and moves one room clockwise.
1		The torch in the current room is lit (1).
	! 3	Guesses that there are 3 rooms in the maze.
1		The torch in the current room is lit (1).
	< 0	Set the torch to extinguished (0) and moves one room counterclockwise.
0		The torch in the current room is extinguished (0).
	< 0	Set the torch to extinguished (0) and moves one room counterclockwise.
0		The torch in the current room is extinguished (0).
	! 4	Guesses that there are 4 rooms in the maze.

In the first test case, the initial state of the torches is 101 in the clockwise order, and initially you are at the first torch. Here are the state of the torches after each of the query.

$$\underline{1}01 \xrightarrow{> 0} 0\underline{0}1 \xrightarrow{> 1} 01\underline{1} \xrightarrow{< 0} 0\underline{1}0 \xrightarrow{< 1} \underline{0}10 \xrightarrow{> 0} 0\underline{1}0$$

This page is intentionally left blank.